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**PATTERNS AND POTENTIALS OF PERU'S INTERNATIONAL TRADE:
A GRAVITY APPROACH**

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Jinhwan OH

Abstract Using the gravity model, this study examines Peru's trade patterns by analyzing the country's bilateral trade flows with 186 countries for over a period of 22 years (1990–2011). The empirical results using the Tobit model for the entire dataset are consistent with the general prediction of the gravity model (positive coefficients for economic size and negative coefficients for distance). Among its thirty main partners, Peru has an unrealized trade potential with Argentina, United States, Canada, Brazil, Mexico, Colombia, United Kingdom, France, Germany and Venezuela. Despite the fact that Peru has trade agreements in place with most of these partners, it seems that Peru has not sufficiently utilized these agreements.

Keywords: Peru, Trade potential, Gravity Model, Regional Integration, Tobit Model

1. Introduction

Peru is located in the southwestern part of America, sharing its border with Ecuador, Colombia, Brazil, Bolivia, Chile and the Pacific Ocean to the west. Peru has experienced robust economic growth in recent years, facing favorable external conditions and a sustained process of economic reforms. The average real Gross Domestic Product (GDP) growth rate between 2002 and 2008 was 6.7%, about 2% higher than the average for South American countries. In spite of the global recession, the country experienced a positive growth (0.9%) in 2009, at a time when South American economies shrunk by 0.3% on average. In 2011, the GDP grew at a rate of 6.9% (Central Reserve Bank of Peru, 2011:13).

Peru's solid economic growth has been accompanied by a continuous process of liberalization and modernization of its trade regime. Initiated in the early 1990s, the liberalization trend became dominant since 2000 when Comprehensive Economic Partnerships was adopted. Peru has placed a high priority on establishing preferential trade agreements both multilaterally and bilaterally. Multilaterally, Peru is a member of the Andean Community (CAN), the Latin American Integration Association (ALADI), the Asia-Pacific Economic Cooperation (APEC) forum and the World Trade Organization (WTO). At the bilateral level, free trade agreements (FTAs) with the United States, Chile, Canada and Singapore came into force in 2009. The FTA with China came into effect in March 2010; FTAs with the EU, Korea, Thailand, Mexico, Japan and Panama were adopted in 2011 and 2012. Currently, over 90% of Peru's exports are destined to countries with which Peru has signed agreements (International Trade Centre, 2012:8-10).

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Despite Peru's recent active involvement in world trade, however, there have been very few empirical studies analyzing Peru's trade patterns. Most studies on Peru's foreign trade are qualitative in nature, as they focus on volume, direction and composition of trade flows. In this context, this study aims to analyze the determining factors of Peru's bilateral trade flows and estimate its potentials. This study is particularly interested in the gravity model, which is one of the most frequently used methods in empirical literature of international trade. There have been a tremendous volume of studies measuring the bilateral trade pattern utilizing this model.

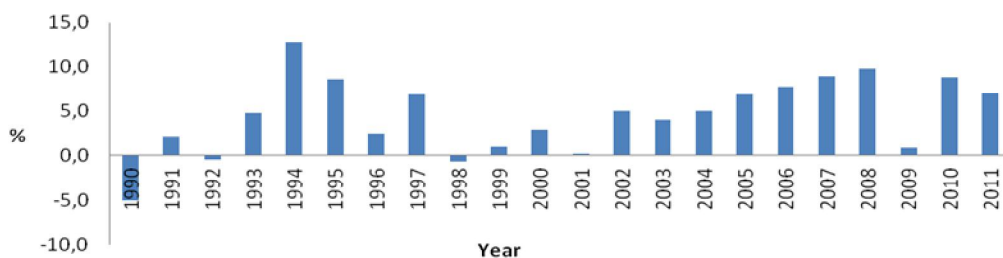
Sohn (2005) evaluated Korea's bilateral trade with its 30 trading partners. The empirical results of the study show that the gravity model is effective in explaining Korea's bilateral trade flows, and that South Korea needs to pursue free trade agreements with Japan and China. Oh and Tumurbaatar (2011) examined the trade patterns of a landlocked country, Mongolia, finding that Mongolia's exports are distorted by its geographical location; however, its imports follow the prediction of the gravity model. Montenegro and Soto (1996) found that Cuba's trade flows are severely distorted due to external economic sanctions, and its trade with the U.S. will soar 70% from zero in the case of trade liberalization. The study of Cadot, Dutoit and Yaye (2008) estimated a gravity equation in order to assess the extent of Bolivia "undertrades." They find that, on an aggregate level, Bolivia "under-exports" by a margin of about 10% under predicted values but does not "under-import;" instead, it "over-imports" by a small and stable margin of about 3% above the predicted values.

In the same direction to the previous studies, this study addresses the following questions: Does the gravity model explain Peru's bilateral trade flows? Which countries would be Peru's desirable potential partners? What are the implications for Peru's trade policy? This study examines these questions by using a comprehensive dataset covering 186 countries over a period of 22 years. The rest of the paper is structured as below. Section 2 presents an overview of Peruvian foreign trade. Section 3 describes the model, data and methodology used in this study. Section 4 outlines the results of the empirical analysis and section 5 addresses the conclusions along with important policy implications.

2. Overview of Peru's International Trade

Peru's recent performance on rapid economic growth, as shown in Figure 1, may be associated with its trade liberalization.

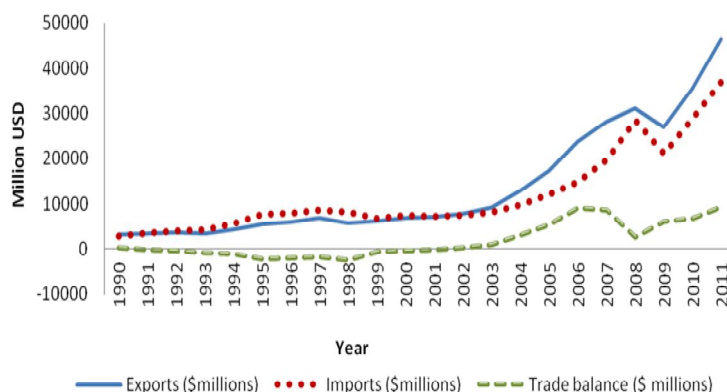
Figure 1. GDP growth of Peru (annual %)



Source: Central Reserve Bank of Peru (Annual Series, 2011)

In 2011, Peru's trade/GDP ratio was 53.44 percent, almost double of that in 1990, and its trade balance had turned into a surplus since 2001. Figure 2 indicates that in 2011, Peru's trade recorded a surplus of US\$ 9,300 million, which is significantly larger than that of the previous year, which is US\$ 6,750 million (Central Reserve Bank of Peru, 2011:71).

Figure 2. Export and import trend for Peru



Source: Central Reserve Bank of Peru (Annual Series, 2011)

Table 1. Composition of Peruvian exports (million USD)

Year	Mining	Petroleum and derivates	Agricultural	Fishing	Chemical and metal products	Textiles	Others
1990	1,480.54	258.20	293.76	452.35	352.12	364.35	78.49
1991	1,534.82	169.33	351.66	549.82	301.22	392.13	94.17
1992	1,819.88	196.20	278.40	527.96	301.50	342.99	111.15
1993	1,472.55	182.12	269.85	717.73	307.18	324.33	110.90
1994	1,970.82	158.92	472.83	980.47	321.02	395.76	124.30
1995	2,615.69	235.55	621.28	1,010.61	429.96	440.66	137.68
1996	2,654.44	353.16	620.41	1,120.76	483.58	454.53	190.77
1997	2,730.51	376.54	811.56	1,403.42	627.48	572.58	302.47
1998	2,746.70	232.54	624.87	634.78	656.79	533.55	327.53
1999	3,008.02	250.78	687.78	791.16	525.64	575.41	248.74
2000	3,220.13	380.73	642.97	1,131.45	573.72	700.68	305.23
2001	3,205.29	391.34	644.20	1,123.23	649.14	664.23	348.30
2002	3,808.95	451.06	766.01	1,056.15	587.83	676.65	367.25
2003	4,689.91	620.98	847.71	1,026.26	677.71	823.25	404.91
2004	7,123.82	645.96	1,125.74	1,380.81	942.25	1,092.38	498.22
2005	9,789.85	1,525.62	1,338.77	1,625.68	1,222.01	1,275.11	590.63
2006	14,734.51	1,817.70	1,793.79	1,768.07	1,594.97	1,472.57	648.53
2007	17,439.29	2,306.22	1,972.58	1,959.69	1,931.00	1,736.47	748.50
2008	18,100.98	2,681.47	2,598.58	2,419.33	2,277.36	2,025.85	914.97
2009	16,382.32	1,920.52	2,461.29	2,201.31	1,771.56	1,494.77	729.95
2010	21,722.81	3,088.00	3,164.54	2,525.83	2,535.85	1,557.70	969.95
2011	27,361.47	4,704.33	4,502.83	3,146.23	3,236.73	1,985.57	1,331.34

Source: Central Reserve Bank of Peru (Annual Series, 2011)

Peru's exports grew on an average of 20% annually between 2001 and 2011, compared to only 9% in the previous decade. This increase was largely driven by exports of minerals and petroleum. Rich in mineral resources, Peru's top exports are copper, gold, zinc and lead. Excluding minerals and petroleum, the most important export sectors are raw and processed agro-based products, including fisheries, metal manufactures and textiles. Although the sector composition of Peruvian exports has not significantly changed over the two decades, an increasing reliance on minerals and petroleum has become dominant over the two decades. Imports also grew between 2001 and 2011 at an average rate of 17%. Chemicals, plastics and rubber-based products are the largest imports, providing essential inputs for domestic, agricultural and industrial production. Capital goods, such as non-electric machinery, transport equipment as well as computers, telecommunication and consumer electronics are also major sectors (Central Reserve Bank of Peru, 2011:71-84).

In the 1990s, the U.S. and Japan were Peru's top exporting partners, whereas the U.S. and Chile were Peru's major importing countries. However, in the 2000s, China stood out as Peru's major partner. In 2011, Peru's trade with China and the U.S. accounted for about a third of Peruvian exports and imports. Peru's major exporting goods to the United States were petroleum products (17%), gold (15%), textiles (13%), copper (6%) and coffee (6%). On the other hand, diesel accounted for 19% of Peru's imports from the United States, followed by wheat (4%) and cargo vehicles (2%). Peru's main exports to China were copper (45%), iron (14%) and fishmeal (15%). The major imports from this Asian country were data processing, digital and telecommunications equipment (10%), mobile phones (6%) and motorcycles and other vehicles (3%) (Central Reserve Bank of Peru, 2011:71-84).

Table 2. Composition of Peruvian imports (million USD)

Year	Raw material and inputs	Capital goods	Consumer goods	Others
1990	1,333.42	885.82	338.27	364.38
1991	1,514.05	934.65	754.69	391.91
1992	1,780.93	1,062.70	903.95	253.82
1993	1,890.16	1,142.20	941.12	186.94
1994	2,231.85	1,683.50	1,353.79	230.08
1995	3,220.90	2,385.43	1,784.90	341.66
1996	3,229.58	2,406.87	1,847.03	380.74
1997	3,422.31	2,791.35	1,899.52	422.36
1998	3,359.51	2,562.44	1,922.26	374.54
1999	2,979.85	2,117.41	1,467.64	145.60
2000	3,610.55	2,113.98	1,494.21	138.83
2001	3,551.19	1,921.28	1,634.90	97.11
2002	3,740.36	1,842.27	1,754.13	56.03
2003	4,339.89	1,974.23	1,841.29	49.44
2004	5,363.63	2,360.98	1,995.13	85.04
2005	6,599.90	3,063.55	2,307.76	110.40
2006	7,981.42	4,123.38	2,616.10	123.18
2007	10,428.55	5,854.32	3,188.92	118.74
2008	14,556.35	9,232.58	4,520.10	140.15
2009	10,076.46	6,849.65	3,962.36	122.22
2010	14,023.48	9,073.70	5,488.74	229.39
2011	18,255.15	11,665.43	6,691.53	354.60

Source: Central Reserve Bank of Peru (Annual Series, 2011)

3. Model Data and Methodology

This paper uses a comprehensive dataset between 1990 and 2011 which covers its 186 trading partners. Cheng and Wall (2005) addressed the advantage of using a panel data; it avoids the problem of misspecifications and biased estimates of the volume of bilateral trade that could be caused by using a single year cross-sectional data. Xuan (2010) argued that a panel data, which is a cross-sectional time-series, tend to increase the sample size, thereby reducing the multicollinearity among the variables.

Very importantly, this study uses Tobit Model to deal with zero values in export and import as dependent variables. It is essential to treat zero trade values (Santos and Tenreyro (2007) and Helpman *et al* (2008)) as left-censored, which account for approximately one third of the entire observations in this dataset.

As per explanatory variables, the product of GDP between Peru and its partners, product of per capita GDP and distances between the two countries are used as basic variables. Referring to Frankel (1997), Sohn (2005) and Oh and Prasai (2012), the Linder variable and several other dummies were then augmented to capture the impact of certain important factors on Peru's bilateral trade. The augmented gravity equation is thus expressed as follows:

$$\ln X_{pjt} \text{ or } \ln M_{pjt} = \alpha + \beta_1 \ln(\text{GDP}_{pt} * \text{GDP}_{jt}) + \beta_2 \ln(\text{PCGDP}_{pt} * \text{PCGDP}_{jt}) + \beta_3 \ln \text{DIST}_{pj} + \beta_4 \ln \text{LINDER}_{pjt} + \beta_5 \text{LOCKED}_j + \beta_6 \text{APEC}_{jt} + \beta_7 \text{ANDEAN}_{jt} + \varepsilon_{pjt}$$

where X_{pjt} and M_{pjt} is the bilateral export or import between Peru (P) and its trading partner (country j) in year t (1990, 1991, 1992, ..., 2011); $\text{GDP}_{pt} * \text{GDP}_{jt}$ is the product of GDP of Peru and its trading partner countries in year t; $\text{PCGDP}_{pt} * \text{PCGDP}_{jt}$ is the product of per capita GDP of Peru and its trading partner countries in year t; DIST_{pj} is the distance between Peru and its partner countries; LINDER_{pjt} is the absolute difference of per capita GDP between Peru and its trading partner countries in year t; $\text{LOCKED}_j = 1$, if trading partner countries are landlocked, and zero elsewhere; $\text{APEC}_{jt} = 1$, if trading partner countries are members of APEC in year t, and zero elsewhere; $\text{ANDEAN}_{jt} = 1$, if trading partner countries are members of ANDEAN in year t, and zero elsewhere; ε_{pjt} are residuals.

Export and import data are from the International Monetary Fund Direction of Trade Statistics (IMF DOTS) and measured in million U.S. dollars. The GDP and per capita GDP have been obtained from the World Bank's (2012) World Development Indicators. The great-circle data between Peru's capital city and its trading partners' capital cities were taken from www.distancefromto.net, expressed in kilometers.

The product of the GDP serves as a proxy of the economic size in terms of both production capacity and market size. When a country's economy expands, it is more likely to achieve economies of scale and thus, increase their exports. It also creates a large domestic market for imported goods from other countries. Therefore, the sign of β_1 is expected to be positive ($\beta_1 > 0$). Following Oh and Prasai (2012), this study uses one-year lagged GDP in order to minimize the endogeneity problem, thereby avoiding a reverse causality issue.

The product of per capita GDP measures the income level or purchasing power. The sign of this coefficient is expected to be positive, meaning that a country trades more with higher income countries. However, the empirical results in several studies are oftentimes unintuitive (Montenegro and Soto, 1996: 54-55). In this regard, Bergstrand (1989) argued that this sign is ambiguous and depends on the factor intensity of traded goods.

Geographical distance represents a barrier to trade, which is a proxy for transport costs. The greater the distance, the larger the resistance to trade. Therefore, the expected sign is negative, implying that a country trades more with its neighbors and less with distant countries.

Linder (1961) tests the Linder Hypothesis. It argues that countries with similar income tend to trade more. Following Montenegro and Soto's (1996) approach, this study measures the absolute difference of per capita GDPs between Peru and its partners. This variable reveals information on the structure of trade between the two countries. If countries trade more when their economies differ, as was predicted by the traditional trade theories based on comparative advantage, the expected sign is positive. However, if countries trade more when their economies are similar, as was predicted by the new trade theory based on increasing returns and product differentiation, a negative sign is expected.

Landlocked countries trade less with other countries due to higher transportation costs. Therefore, the sign of this dummy is expected to be negative. Moreover, as a member of the APEC or the ANDEAN, Peru is expected to trade more with other member states, making its expected sign positive.

This paper adopts the random effect model as an analysis tool, following Baldwin (1994), Gros and Gonciarz (1996) and Oh and Prasai (2012). The best part of using the random effect in the gravity model is that the time invariant variables (e.g. distance) are not dropped. The results from the Hausman Test, provided in Appendix 1, confirm the idea of using the random effect. Moreover, this study uses White's robust standard errors to correct heteroskedasticity.

This study mainly deals with two sets of regressions. The first one considers the entire dataset and incorporates two models (basic and augmented) for exports and imports. In the second part, the dataset is divided into two time periods (before and after the implementation of Comprehensive Economic Partnerships). After these regression analyses, this study compares the gravity based fitted or predicted trade volumes (P) with the actual ones (A) in order to analyze Peru's trade potentials and figure out good candidates as its FTA partners.

4. Results

In both the basic and augmented models, the positive sign of GDP and per capita GDP as well as the negative coefficient of distance are consistent with the prediction of the gravity model, both for exports and imports. For example, it is found that a 1% increase of the product of GDP explains, in general, a 2% increase of trade flows, and a 1% decrease of distance between Peru and its partners is associated with a 2-4% increase of trade volume between the two countries. In the augmented model, the coefficient for Linder is negative for exports, meaning that Peru's exports flows are

determined based on the New Trade Theory type of product differentiation, and positive for imports, indicating that import flows are made up of heterogeneous goods with different economies, as per the Heckscher–Ohlin type of comparative advantage. More specifically, Peru exports more to countries with similar income levels and imports more from countries with different income levels.

Overall, the results indicate that the coefficients of landlocked and dummies variables, APEC and ANDEAN show the expected sign. The only exception is the negative sign presented in the APEC coefficient for imports.

Table 3. Overall results

Explanatory variables	Basic		Augmented	
	Log (export)	Log(import)	Log(export)	Log(import)
Log (product of GDP)	2.660*** (0.170)	3.113*** (0.160)	2.621*** (0.159)	3.229*** (0.174)
Log (product of per capita GDP)	0.408* (0.246)	0.627*** (0.217)	0.214 (0.240)	0.479* (0.245)
Log (Distance)	-5.139*** (0.644)	-3.597*** (0.561)	-4.666*** (0.654)	-3.205*** (0.666)
Log (Linder)			-0.037 (0.176)	0.306* (0.179)
Landlocked			-5.172*** (0.826)	-0.245 (0.830)
APEC			0.332 (0.811)	-2.779*** (0.839)
ANDEAN			0.001 (2.756)	2.822 (2.811)
Constant	-46.601*** (7.645)	-83.084*** (6.963)	-42.596*** (7.889)	-88.401*** (8.063)
Rho	0.496	0.430	0.435	0.454
Observations	3723	3710	3723	3710
Left Censored	1046	1038	1046	1038

Note: Random effect tobit model; Standard errors in parenthesis; *, **, *** significance at 10%, 5%, 1%, respectively.

In the second series of regressions, in order to check the robustness of the first results and determine the impact of free trade agreements on Peru's trading patterns, this study divides the dataset into two groups based on the time periods. Liberalization trade policies peaked in 2000 when the Policy on Comprehensive Economic Partnerships was adopted. To determine whether this policy had a significant impact on Peru's trade patterns, the data was broken down into two parts, before (1990–2000) and after (2001–2011) its implementation. The results are presented in Table 5.

In general, this table reveals that those two time periods do not provide significant differences, except for a few parts. The coefficient for per capita GDP for exports was negative during the earlier period, but became positive in the later period. The Linder variable was negative for exports and positive for imports in the first period, changing to the opposite sign in the second period. Overall, this policy does not have a significant impact on the determining factors for Peru's trade flows.

Having estimated the gravity model for Peru's bilateral flows of exports and imports, this section proceeds from the results for the basic model of Table 4 and provides Peru's gravity-based predicted trade volume. Following Gul and Yasin (2011), this predicted volume (P) is divided by the actual flows (A) in order to evaluate Peru's trade potential, and to forecast its future trade direction.

Table 4. Results before and after the Policy on Comprehensive Economic Partnerships

	Log (export)	Log (export)	Log (import)	Log (import)
Explanatory variables	1990-2000	2001-2011	1990-2000	2001-2011
Log (product of GDP)	2.730***	2.090***	3.343***	2.254***
	(0.208)	(0.176)	(0.255)	(0.137)
Log (product of per capita GDP)	-0.128	0.126	0.042	0.567***
	(0.333)	(0.264)	(0.393)	(0.208)
Log (Distance)	-4.294***	-4.801***	-3.807***	-2.783***
	(0.811)	(0.681)	(0.928)	(0.531)
Log (Linder)	-0.044	0.020	0.308	0.040
	(0.252)	(0.215)	(0.310)	(0.178)
Landlocked	-4.758***	-6.180***	-2.316*	-0.050
	(1.075)	(0.873)	(1.227)	(0.669)
APEC	1.267	0.389	-0.812	0.213
	(1.002)	(1.166)	(1.198)	(0.913)
ANDEAN	1.513	-0.453	4.656	2.754
	(3.368)	(2.857)	(3.824)	(2.232)
Constant	-40.453***	-20.327**	-75.717***	-58.718***
	(11.206)	(8.850)	(13.015)	(7.042)
Rho	0.542	0.533	0.516	0.471
Observations	1747	1976	1734	1976
Left Censored	573	473	717	321

Note: Random effect tobit model; Standard errors in parenthesis; *, **, *** significance at 10%, 5%, 1%, respectively.

If the value of the P/A exceeds unity, this implies that Peru's trade with the respective country is underrepresented and has the potential to expand further. For the sake of simplicity, this study divides the entire time span (1990-2011) into three sub-periods and calculates the average values of the predicted (P) and actual trade (A). In Tables 6 and 7, the results for Peru's main thirty trading partners (listed in Table 3, in the Annex) are shown in descending order according to their P/A values.

Our estimations reveal that, among its thirty main partners, Peru's exports to Argentina, United States, Canada, Brazil, Mexico, Colombia, United Kingdom, France, Germany and Venezuela are underrepresented. Despite the fact that Peru has trade agreements in place with most of these partners, it seems that Peru has not sufficiently utilized these agreements. Given that Argentina and Brazil are consistently underrepresented, Peru needs to place priority on enhancing intra-regional trade with its neighboring large economies.

Table 5. Exports: Trade potential of Peru with its major export trading partners

1990-1999		2000-2010		2011	
Country	P/A	Country	P/A	Country	P/A
1 United States	1.23	Argentina	1.24	Argentina	1.26
2 Argentina	1.20	United States	1.23	United States	1.24
3 Brazil	1.16	Brazil	1.17	Brazil	1.17
4 Mexico	1.12	Mexico	1.15	Mexico	1.17
5 Colombia	1.09	France	1.11	Colombia	1.12
6 Canada	1.08	Colombia	1.11	United Kingdom	1.12
7 France	1.07	Venezuela, Rep. Bol.	1.06	France	1.10
8 Venezuela, Rep. Bol.	1.06	Japan	1.06	Venezuela, Rep. Bol.	1.09
9 Japan	1.05	Canada	1.05	Japan	1.05
10 Germany	1.03	United Kingdom	1.05	Germany	1.04
11 Chile	1.01	Germany	1.05	Australia	1.02
12 Ecuador	1.00	Italy	1.01	Chile	1.01
13 United Kingdom	1.00	Ecuador	1.00	Canada	1.01
14 Italy	0.98	Chile	0.99	Ecuador	1.00
15 Spain	0.97	Australia	0.99	Italy	0.99
16 Norway	0.91	Sweden	0.97	Dominican Republic	0.98
17 Russia	0.91	Spain	0.96	Spain	0.95
18 Denmark	0.91	Norway	0.95	Bolivia	0.94
19 Bolivia	0.89	Netherlands	0.92	Netherlands	0.94
20 Netherlands	0.89	Bolivia	0.92	Sweden	0.93
21 Switzerland	0.88	Guatemala	0.92	Denmark	0.92
22 Korea, Republic of	0.83	India	0.89	India	0.91
23 China, P.R.: Mainland	0.81	Korea, Republic of	0.88	China, P.R.: Mainland	0.91
24 Indonesia	0.76	China, P.R.: Mainland	0.87	Norway	0.90
25 China, P.R.: Hong Kong	0.75	Finland	0.86	Belgium	0.89
26 Panama	0.75	Switzerland	0.85	Korea, Republic of	0.87
27 Iran, I.R. of	0.72	Panama	0.76	Finland	0.83
28 Thailand	0.72	Thailand	0.74	Thailand	0.74
29 Malaysia	0.64	Bulgaria	0.59	Philippines	0.74
30 Philippines	0.64	-	-	Namibia	0.55

P = predicted trade using estimates of the basic gravity model, A = actual trade. $P/A > 1$ indicates high trade potential, otherwise, exhausted potential. Ranked according to (P/A). Note: In the second period, the value for Belgium was dropped in order to avoid a biased result.

Regarding imports, countries such as the United States, United Kingdom, Japan, France, Canada, Brazil and Germany are underrepresented. Meanwhile, the value of the P/A ratio indicates that Peru has attained its potential with Thailand, Ecuador, Bolivia, China, South Korea and Chile. Conformity assessment requirements and technical regulations represent serious barriers for importers, meaning the existence of a bottleneck in the testing and certification procedures within Peru. This resulted in the delays of administrative procedures along with excessive amount of paperwork. Charges, taxes and other para-tariff measures also represent a major challenge for Peruvian importers, which can explain why Peru has not expanded its imports flows from the above mentioned potentials markets (International Trade Centre, 2012:15).

Table 6. Imports: Trade potential of Peru with its major import trading partners

1990-1999		2000-2010		2011	
Country	P/A	Country	P/A	Country	P/A
1 United States	1.21	United States	1.25	United States	1.24
2 Japan	1.11	United Kingdom	1.16	United Kingdom	1.19
3 United Kingdom	1.09	Japan	1.14	Japan	1.15
4 France	1.08	France	1.12	France	1.14
5 Brazil	1.07	Canada	1.11	Canada	1.12
6 Canada	1.07	Germany	1.09	Brazil	1.11
7 Germany	1.05	Brazil	1.09	Germany	1.10
8 Mexico	1.05	Mexico	1.07	Venezuela, Rep. Bol.	1.09
9 Italy	1.03	Italy	1.06	Mexico	1.07
10 Argentina	1.01	Argentina	1.04	Argentina	1.06
11 Australia	0.97	Netherlands	1.02	Italy	1.06
12 Netherlands	0.95	Venezuela, Rep. Bol.	0.99	Spain	1.02
13 Spain	0.95	Spain	0.99	Netherlands	1.02
14 Venezuela, Rep. Bol.	0.94	Colombia	0.98	Colombia	1.02
15 Colombia	0.94	Switzerland	0.96	Sweden	0.97
16 Russia	0.92	Sweden	0.95	China,P.R.: Mainland	0.96
17 Switzerland	0.91	Russia	0.93	Belgium	0.96
18 Denmark	0.90	Angola	0.92	Chile	0.95
19 China,P.R.: Mainland	0.88	Chile	0.92	Turkey	0.93
20 Sweden	0.88	China,P.R.: Mainland	0.92	Korea, Republic of	0.92
21 Chile	0.86	Korea, Republic of	0.91	India	0.91
22 Korea, Republic of	0.86	India	0.88	Russia	0.89
23 Ecuador	0.83	Finland	0.88	China,P.R.: Hong Kong	0.88
24 China,P.R.: Hong Kong	0.81	Ecuador	0.84	Ecuador	0.87
25 Uruguay	0.80	Bolivia	0.80	Bolivia	0.83
26 Bolivia	0.73	Nigeria	0.76	Indonesia	0.83
27 Singapore	0.72	Thailand	0.75	Paraguay	0.78
28 Thailand	0.71	Malaysia	0.75	Thailand	0.77
29 New Zealand	0.71	Panama	0.74	Nigeria	0.72
30 Panama	0.60	Paraguay	0.74	Angola	0.64

P = predicted trade using estimates of the basic gravity model, A = actual trade. $P/A > 1$ indicates high trade potential, otherwise, exhausted potential. Ranked according to (P/A).

5. Conclusion

Using the gravity model, this study examines Peru's trade pattern by analyzing a panel dataset of the country's bilateral trade flows with 186 countries for over a period of 22 years (1990–2011). The empirical results based on the random effect models are basically consistent with the predictions of the gravity model, and the coefficients for most of the variables are, in general, as expected. When the dataset was breaking down into two parts, before (1990–2000) and after (2001–2011) the implementation of Comprehensive Economic Partnerships, no major significant differences were found between the two periods. Among its thirty main partners, Peru's exports to Argentina, United States, Canada, Brazil, Mexico, Colombia, United Kingdom, France, Germany and Venezuela are underrepresented. Although Peru has trade agreements in place with most of these partners, it seems that Peru has not sufficiently utilized these agreements. Since Argentina and Brazil are consistently underrepresented, Peru needs to prioritize lifting intra-regional trade with its

neighboring large economies. Regarding imports, countries such as the United States, United Kingdom, Japan, France, Canada, Brazil and Germany are underrepresented. Conformity assessment requirements, technical regulations, charges, taxes and other para-tariff measures explain why Peru has not expanded its imports flows from those potentials markets.

As a topic for future research on the trading patterns of other Latin American countries, such as Argentina, Brazil and Colombia, could be examined in order to see whether their patterns are different from those of Peru. By doing so, Peruvian policy makers could use this information to design and implement effective policies in order to enhance Peru's intraregional trade with its neighboring economies.

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Annex

Table 7. Peru's major trade partners with respect to average exports and imports

1990-1999 (Million USD)			
Country	Exports	Country	Imports
1 United States	1,099.71	United States	1,854.55
2 Japan	374.37	Chile	359.32
3 United Kingdom	321.95	Colombia	338.15
4 Germany	256.56	Spain	304.94
5 China,P.R.: Mainland	255.78	Japan	304.86
6 Switzerland	210.65	Brazil	300.36
7 Italy	200.39	Germany	264.33
8 Brazil	175.70	Argentina	259.15
9 Netherlands	166.31	Venezuela, Rep. Bol.	244.85
10 Colombia	112.00	Mexico	172.09
11 Korea, Republic of	110.09	Korea, Republic of	143.81
12 Canada	107.69	Italy	143.20
13 Mexico	106.20	Canada	125.71
14 Spain	102.71	Ecuador	106.07
15 Venezuela, Rep. Bol.	102.70	France	97.12
16 Chile	101.53	Panama	94.06
17 France	74.25	United Kingdom	90.12
18 Bolivia	69.43	Switzerland	85.04
19 Ecuador	61.17	Bolivia	82.96
20 China,P.R.: Hong Kong	38.36	China,P.R.: Mainland	82.60
21 Malaysia	37.28	Sweden	70.42
22 Argentina	30.76	Netherlands	61.78
23 Iran, I.R. of	26.50	Uruguay	50.57
24 Philippines	26.12	New Zealand	48.98
25 Thailand	19.23	China,P.R.: Hong Kong	29.24
26 Indonesia	17.44	Denmark	23.88
27 Norway	17.35	Australia	21.83
28 Panama	16.72	Singapore	17.40
29 Russia	16.55	Thailand	16.84
30 Denmark	13.93	Russia	15.55

2000-2010 (Million USD)			
Country	Exports	Country	Imports
United States	4,000.49	United States	3,514.33
China, P.R.: Mainland	2,183.43	China, P.R.: Mainland	1,692.87
Switzerland	1,332.58	Brazil	1,211.44
Canada	1,197.86	Chile	888.84
Japan	1,021.49	Ecuador	866.68
Chile	902.42	Colombia	778.07
Germany	640.11	Argentina	726.57
Spain	611.32	Japan	604.36
United Kingdom	583.19	Mexico	582.98
Brazil	523.94	Germany	501.15
Italy	482.55	Spain	467.46
Netherlands	442.46	Korea, Republic of	451.04
Korea, Republic of	427.99	Venezuela, Rep. Bol.	336.41
Colombia	404.17	Italy	291.09
Venezuela, Rep. Bol.	392.95	Canada	260.94
Ecuador	333.93	Angola	207.00
Mexico	238.59	Nigeria	188.92
Bolivia	196.01	India	185.41
Panama	175.14	France	169.39
France	143.10	Bolivia	166.52
Finland	130.86	Switzerland	129.13
Bulgaria	113.45	United Kingdom	122.96
India	103.20	Sweden	115.36
Sweden	85.87	Thailand	114.92
Australia	67.94	Russia	90.53
Argentina	62.18	Netherlands	89.93
Thailand	50.86	Paraguay	88.33
Norway	47.20	Panama	86.97
Guatemala	47.11	Malaysia	82.91
Belgium	45.45	Finland	79.08

2011 (Million USD)			
Country	Exports	Country	Imports
China,P.R.: Mainland	7,150.73	United States	9,151.12
United States	5,942.36	China,P.R.: Mainland	5,121.03
Canada	4,457.15	Brazil	2,489.21
Japan	2,162.38	Chile	2,218.70
Spain	2,115.55	Argentina	1,990.94
Chile	1,883.84	Ecuador	1,645.45
Korea, Republic of	1,778.03	Colombia	1,528.75
Germany	1,613.03	Korea, Republic of	1,505.85
Brazil	1,367.72	Mexico	1,415.01
Italy	1,237.25	Germany	1,014.94
Ecuador	995.42	Japan	1,008.68
Colombia	800.54	Nigeria	769.29
Netherlands	705.58	Spain	619.84
Belgium	664.55	India	614.53
Venezuela, Rep. Bol.	541.97	Italy	591.53
Bolivia	456.63	Canada	573.82
Finland	417.36	Russia	571.44
Mexico	377.59	Bolivia	428.95
United Kingdom	356.66	Thailand	332.38
India	350.66	Angola	323.95
Sweden	321.78	Turkey	315.48
France	316.82	France	282.82
Thailand	277.91	Belgium	275.23
Norway	246.47	Netherlands	238.85
Namibia	150.77	Sweden	234.68
Philippines	136.54	China,P.R.: Hong Kong	230.62
Argentina	123.12	United Kingdom	189.24
Denmark	115.88	Indonesia	178.18
Australia	107.42	Paraguay	169.53
Dominican Republic	105.14	Venezuela, Rep. Bol.	168.50

Source: International Monetary Fund. DOTS Database. Note: Amounts are average values within each period.